

Title: Sign It! *Shapes and Patterns in Our World*

Brief Overview:

This unit will focus on patterns, functions and algebraic thinking. Students will determine core patterns and shapes with special emphasis on geometric figures and transformations. Students will identify geometrical and directional shapes and signs in their community and immediate environment. Students will culminate these experiences by graphing data and developing a *Sign Park*.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards

- **Content Standards**

- **Algebra**

- *Understand pattern relationships and functions.*
 - *Represent and analyze mathematical situations and structures using algebraic symbols.*
 - *Use mathematical models to represent and understand quantitative relationships.*
 - *Analyze change in various contexts.*

Geometry

- *Analyze characteristics and properties of two and three-dimensional geometric shapes and develop mathematical arguments about geometric shapes.*
 - *Specify locations and describe spatial relationships using coordinate geometry and other representational systems.*
 - *Apply transformations and use symmetry to analyze mathematical situations.*
 - *Use visualization, spatial reasoning, and geometric modeling to solve problems.*
- **Process Standards**

Problem Solving

- *Build new mathematical knowledge through problem solving.*
- *Solve problems that arise in mathematics and in other contexts.*
- *Apply and adapt a variety of appropriate strategies to solve problems.*
- *Monitor and reflect on the process of mathematical problems solving.*

Communication

- *Organize and consolidate mathematical thinking through communication.*
- *Communicate mathematical thinking coherently and clearly to peers teachers and others.*
- *Analyze and evaluate mathematical thinking and strategies of others.*
- *Use the language of mathematics to express mathematical ideas precisely.*

Connections

- *Recognize and use connections among mathematical ideas.*
- *Understand how mathematical ideas interconnect and build on one another to produce coherent whole.*
- *Recognize and apply mathematics in contexts outside of mathematics.*

Representation

- *Create and use representations to organize, record, and communicate mathematical ideas.*
- *Select, apply, and translate among mathematical representations to solve problems.*
- *Use representations to model and interpret physical, social, and mathematical phenomena.*

Links to National Science Education Standards:

• **Science as Inquiry**

Students will represent data and results in multiple ways, such as number tables and graph drawings/ diagrams and artwork, technical and creative writing; use facts to support conclusions; and communicate in a form suited to the purpose and the audience, such as writing instructions that others can follow.

Grade/Level:

Grades kindergarten through 3rd with modification and extensions

Duration/Length:

Four (4) - 60-minute class periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Problem-solving strategies
- Use of a mathematics rubric
- Basic shape recognition
- Ability to distinguish colors

Student Outcomes:

Students will be able to:

- identify patterns and pattern characteristics.
- continue and extend a given pattern.
- name pattern rules and relationships.
- create and design a pattern.
- describe, extend and make generalizations about geometry and numerical patterns.
- represent and analyze patterns and functions using word tables and graphs.
- use concrete pictorial and verbal representations to develop an understanding of invented and conventional and symbolic notations.
- explore various polygons in their community environment.
- identify polygons and create own polygons.
- create a sign park, which will include directional signs.

Materials/Resources/Printed Materials:

- Plain white paper – 6 sheets per group of 3 students or 8 sheets for groups of 4 students.
- Rulers – one per student.
- Crayons – primary colors only: red, yellow and green.
- The National Center on Education and the Economy and the University of Pittsburgh, Performance Standards: Volume 1 Elementary School © 1997.
- Math to Know: Mathematics Handbook; The Great Source Education Group: Houghton Mifflin Company © 2000.
- Janice VanCleave's Geometry for Every Kid: East Activities that Make Learning Geometry Fun; John Wiley & Sons © 1994.
- Grade 3 - Geometry: Experimenting with Shapes and Spatial Relationships; Instructional Fair Inc. ©

Development/Procedures

Perspective

- This unit will require the display of several *charts* that will be used to engage the students in the learning process. These charts should guide students as they reflect and decide upon the problem solving strategies that they will need in order to draw their conclusions. Graphs and charts will also provide students with rich text for journaling as they make connections to the real world.
- As the students explore and describe shapes and patterns, remind them how shapes and patterns appear *everywhere* in our community. The lessons move toward the recognition of *shapes as signs* when they appear in the environment. Signs of caution, announcements, and other directional signs govern the movement of the community. As the students become familiar with the shapes and patterns around them, as the instructor, begin to listen closely as students continue to identify geometric figures and patterns after the unit has ended.
- There is a ***Parent Component/Home Connection*** to this unit; students are required to gather data from their environment, students will collect data on their way home from school. Herein, it is essential that parents are aware of the assignment. This research will form the basis for the beginning of their connection to real life in preparation for lessons three and four. The data the students accumulate as they record a sequence of signs to and from school will be graphed, compared, and scripted. This unit will culminate with the creation of a **Diorama of a Sign Park** that *also* illustrates a pattern. An example of a *Parent Letter* appears in the Teacher's Resource Section of this unit.

Day One: Lesson 1, "See, Touch and Feel"

- In advance, bring a piece of cloth, quilt, wear an outfit or create several colorful patterns, using polygons. ***Display these items around the classroom.*** Include in your classroom a display of a *Math Talk Chart* and a *Connection Chart*, which should be easily accessible to the children. The *Math Talk Chart* will display the vocabulary words used in the unit. The *Connections Chart* will show the relationship of the shapes and patterns found in the environment with respect to what they tell or show the observer.
- Also displayed, and enlarged, if possible, are **Teacher Resource Sheets 1,2,3, and 5**. Teacher Resource Sheet 2 is a mathematics rubric. These are road maps of expected student outcomes. These forms are referred to occasionally throughout the unit, to assist, engage and encourage student reflection and journaling. The day prior to your lesson introduction, introduce and discuss these charts and how they will be used in this, throughout the year.
- Additionally, during the discussion of the purpose of the charts ask the students to define the word *repeating*. Once the word *repeating* has been defined refer to the patterns displayed throughout the room and ask the students to journal their personal description of a pattern and share with others.

- The words *pattern* and *repeating* and all future vocabularies, should be written on the **Math Talk Chart** and included in the spelling words of the week. Repeat this process often. All related vocabulary words must be posted on the **Math Talk Chart**. Sequentially, include the **Connections Chart** and allow students to write words and responses on this chart. Direct student attention around the room, to the corridors, to the playground, and to other classrooms. The objective is to identify where they will begin to find patterns and geometrical shapes on their own.
- For student groups of 4-6 students, a final project could be the creation of a class collage. Each group could create an individual repeating design. Motivate students by asking for 5 volunteers to come up to the front of the classroom. Tell the class that you will use these students to create a pattern. To create a pattern, choose 2 girls and 3 boys. Place these children in a boy girl pattern, and ask students to determine the pattern. Tell students that patterns are *everywhere*. Refer to **Teacher Resource Sheet 4** and play *Snap, Clap and Tap Street*.
- **Student Resource Sheet 1, Pattern Box Lane**, should be made into an overhead transparency. This is a good tool for this kind of lesson and be prepared to use it throughout the unit. The worksheet **Pattern Box Lane** is to be used, with crayons or markers, as a repeating pattern. Model and have students copy *a term*, each entry the smallest part of a pattern. The colors in this pattern are red and blue.
- Model and have students *copy* the *core* of a pattern or the repeating terms and then direct student inquiry toward *continuing patterns* by asking what would come next in each of the examples that are modeled. **Student Resource Sheet 1** is an opportunity for extended and experimental pattern development.
- Homework Assignment/Day 1
In preparation for the Pattern Sign Park Project, explain expectations and how the final assessment project will create a *Pattern Sign Theme Park*. Discuss how they will be collecting data about signs as they drive or walk to and from school for graphing. Further explain that parents/guardians will be informed, in order to assist. Inform the students that a parent /guardian signature is required. Students must **find an example of a repeating pattern** and **bring it to class**, the following day.

Day Two: Lesson Two, “See and Sketch”

- Use **Student Resource Sheet 2, Shape Shifting Square**. This worksheet is blank because students will observe, copy, and continue patterns modeled by the teacher using pattern blocks. Move students from simple examples to more complex patterns. Encourage students to tell how each pattern is continued. This Resource Sheet will prepare students for *Lessons Three and Four*. Students will begin to become familiar with the shapes of signs. Have students journal the definition of pattern with an illustrated example.

- Implementing *See and Sketch* involves taking a local field trip through your school corridor, the playground, or other classroom that contain great examples of geometric shapes. Make certain that you choose a location that is rich in content. Guide the students in these observations and provide inquiry. When students return, ask them to determine the most common geometric figures. Have students journal as to why some shapes are found more than others. Allow additional time for experimenting with pattern blocks.
- Homework Assignment/ Day Two
Provide the students with the Graph Tally Sheet. Explain to students they will graph and categorize the first 25 signs they see on the road to home from school. They will graph this information on the following day. Have students add total numbers of like signs for the graph. Display the graph, compare and contrast the data. In their Math Journal, have them script the day's activities using Math Talk words. The final question of the day should address why certain signs and shapes are more common than others.

Day Three: Lesson Three, “Reality Check”

- The purpose of this lesson is to demonstrate to students that geometrical shapes are in our environment. These different types of polygons are seen in various traffic signs. All of these signs are polygons; however, they don't all have the same number of sides.
- Ask students to think of a shape. Distribute a sheet of quarter plain paper to each student, and have students draw their one shape on this sheet of plain paper. Encourage students to think of closed figures whose sides are all line segments, e.g. polygons. Then color these shapes with the primary color crayons, red, green or yellow. Have students describe their shapes to the class, encourage students to use vocabulary words from previous lessons. Have a few students draw their shapes on the chalkboard/overhead projector and have them use vocabulary words from the *Math Talk Chart* to describe why their shapes are polygons.
- Ask these introductory questions to help focus students: What types of signs do we see in our environment? What shapes are these signs? How many sides do these signs have? What do these signs represent? Are there any particular patterns formed with these signs in our environment? HINT: Look for patterns in the location and color of the signs.
- Use **Student Resource Sheet 3, *Name That Polygon***. This worksheet is designed to direct students' attention toward different environmental signs and shapes. On this worksheet there are various geometric shapes. Students will learn to recognize these signs by making observations from their immediate environment. Students should begin to notice that certain signs are located in particular locations throughout the community. For example, stop signs are located on corners, and yield signs are located in areas where caution is required. Direct students' attention to the various colors of these signs. Ask students, do they see a pattern/relationship between the sign and its color.

Day Four: Lesson Four, “Creating a Park of Patterns”

- The purpose for this final lesson is to give students the hands-on, minds-on experience to assess their understanding of both patterns and their relationship to geometrical shapes. With this activity students will design a park of patterns. These patterns of signs will include various geometric shapes, such as squares, triangle, octagons, rhombi, hexagons, etc. The real-life connections will allow students to incorporate Stop Signs, Yield Signs, Do No Enter Signs, etc. into their pattern park.
- Look for the location of these signs in the park and note the positions of the signs. The goal of this wrap-up lesson is to determine if students have conceptualized the concepts of patterns in the environment by the use of geometrical shapes.
- Depending on funding constraints, it is probably best to have students create a Diorama of a Pattern Sign Park. If funds are not an issue you may want to have student groups construct a two or three-dimensional Pattern Park. Depending upon the creativity of the students these projects can be as elaborate or as simple as allowed. This activity may require two separate 30-minute periods. One period to brain storm and gather materials and another to begin construction. Allow students to use the entire vocabulary list (*Math Talk Chart*) and material from the three previous lessons.
- Display student projects in the classroom. In addition, student groups may give presentations on their projects.

Performance Assessment:

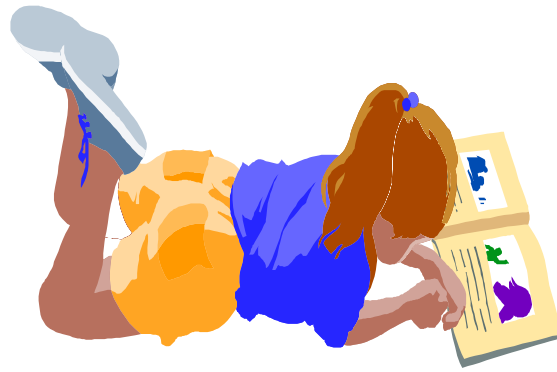
- The performance assessment is based on the Mathematics Rubric (*Refer to Teacher Resource Sheet 2.*).
- The final assessment of this unit is the creation of the Diorama Pattern Sign, which will include various patterns. Here are some examples of patterns that might appear in this diorama park:
 - Square, triangle, square, triangle, square, triangle.....
 - Trapezoid, trapezoid, octagon, trapezoid, trapezoid, octagon.....
 - Rectangle, hexagon, hexagon, hexagon, rectangle, hexagon, hexagon, hexagon.....
- These shapes and patterns may be in the form of Stop Signs, Yield Signs, Do Not Enter Signs, One Way Signs, etc. Some students may create their own messages, however the sign itself must be a polygon, (a closed figure with line segments).
- Based on the mathematics rubric (*See Teacher Resource Sheet 2.*), students will include the following geometrical shapes in their diorama pattern park:
 - squares
 - rhombi
 - octagons
 - trapezoids
 - triangles
 - rectangles
 - hexagons

- The student produces evidence that demonstrates understanding of function and algebra concepts; that is the student uses linear patterns to solve problems; that is:
 - Shows how one quantity determines another in a linear (repeating) pattern, i.e., describes, extends and recognizes the linear pattern by its rule, such as, the total number of legs on a given number of horses can be calculated by counting by fours;
 - Shows how one quantity determines another quantity in a functional relationship based on a linear pattern, e.g. for the “number of people and total number of eyes”, figure out how many eyes 100 people have all altogether.
- The student produces evidence that demonstrates understanding of geometry and measurement concepts; that is, the student uses many types of figures (triangles, squares, rectangles, rhombi, parallelograms, quadrilaterals, and polygons) and identifies the figures by their properties, e.g. symmetry, number of faces, two – three dimensionality, no right angles.

Authors:

Stephanie W. Harris
 Anne Beers Elementary School
 Washington, DC

Kim Cherry
 Glassmanor Elementary School
 Prince George’s County, MD

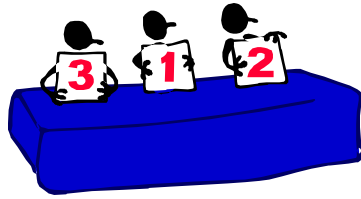


Dear Parents,

_____ will be involved in the study of a unit called *Shapes and Patterns in Our World*. For one night during this unit your child will be responsible for collecting data about signs on the way home from school. As the unit progresses, your child will graph this data. Please be advised that we will need your cooperation in this endeavor.

Thank You!

Sincerely,



Mathematics Rubric

4 – Full Accomplishment

- Accomplish the purpose of the question
- Mathematical communication is clear
- 100% - 90% accurate

3 – Substantial Accomplishment

- Substantial accomplishes the purpose of the question
- Mathematical communication lacks totally clarity
- 89% - 75 % accurate

2 – Partial Accomplishment

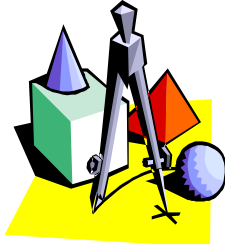
- Partially accomplishes the purpose of the question
- Mathematical communication lacks clarity
- 74% - 60 % accurate

1 – Little Accomplishment

- Partially accomplish the purpose of the question
- Mathematical communication is not clear
- There is limited accuracy
- 59% - 35% accurate

0- No Accomplishment

- Does not accomplish the purpose of the question
- Mathematical communication is not clear
- There is no accuracy
- 34% - 0% accurate



Problem Solving Strategies

Observe Patterns

Use a Model

Pictures and Diagrams

Deductive Reasoning

Inductive Reasoning

Guess and Test

Make a Table

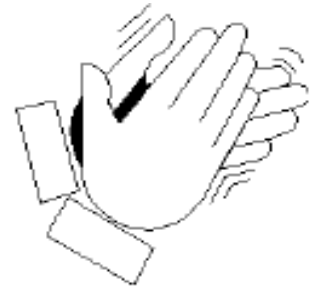
Organize a List

Work Backwards

Solve a simple problem

Write an Equation

Snap, Clap, and Tap Street



Game Cards:

Cut out each of the words below to make cards. Each group must receive a “*snap, clap, tap*” pattern. (It would probably be best to have student groups create their own pattern.) Have the students act out the directions on each card and then trade with other groups. Give the students time to practice their rhythm pattern. Have each group repeat their patterns at least 4-5 times. Remind students that they are expressing a pattern in a *different* way.

SNAP



CLAP

STAMP

TOUCH
YOUR KNEES



Hands
above your
head



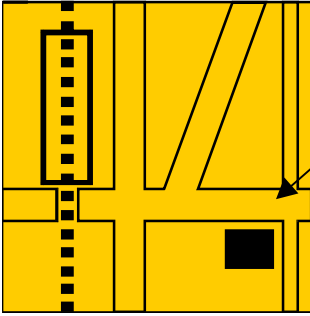
Point to
your chin

Pattern Place

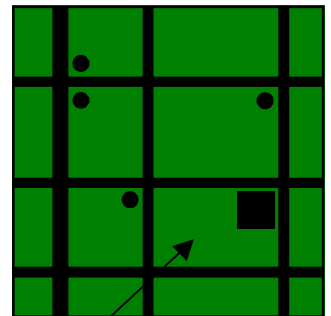


- ☒ **Copy**
- ☒ **Continue**
- ☒ **Describe**
- ☒ **Build when given description**
- ☒ **Create your own**
- ☒ **See patterns and make predictions**
- ☒ **Organize the information and
find regularity in data**

Pattern Box Place

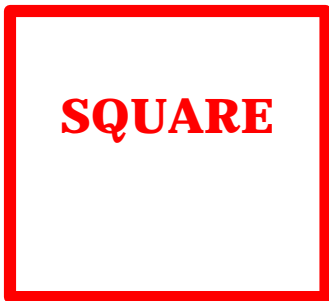


What types of patterns might you find at Pattern Box Place and Pattern Box Lane? Create your own patterns to help with your answer.

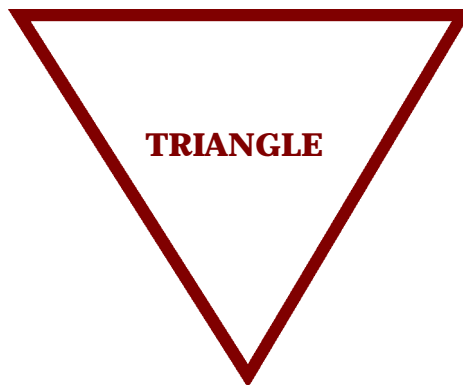


Pattern Box Lane

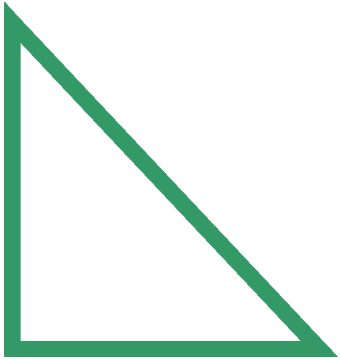
Shape Shifting Square

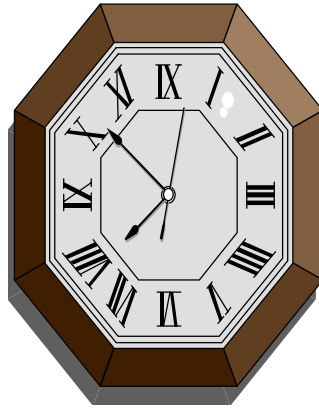


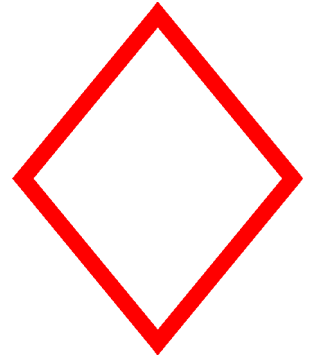
Create your own polygon...



Name that polygon.....

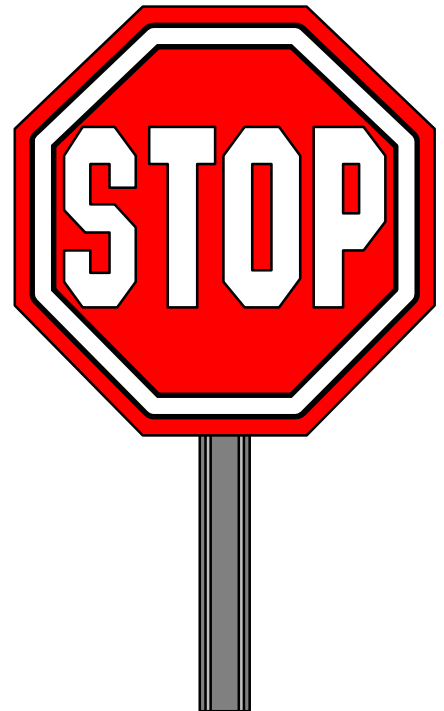




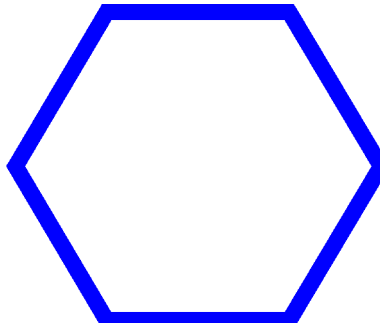












How many are out there.....

